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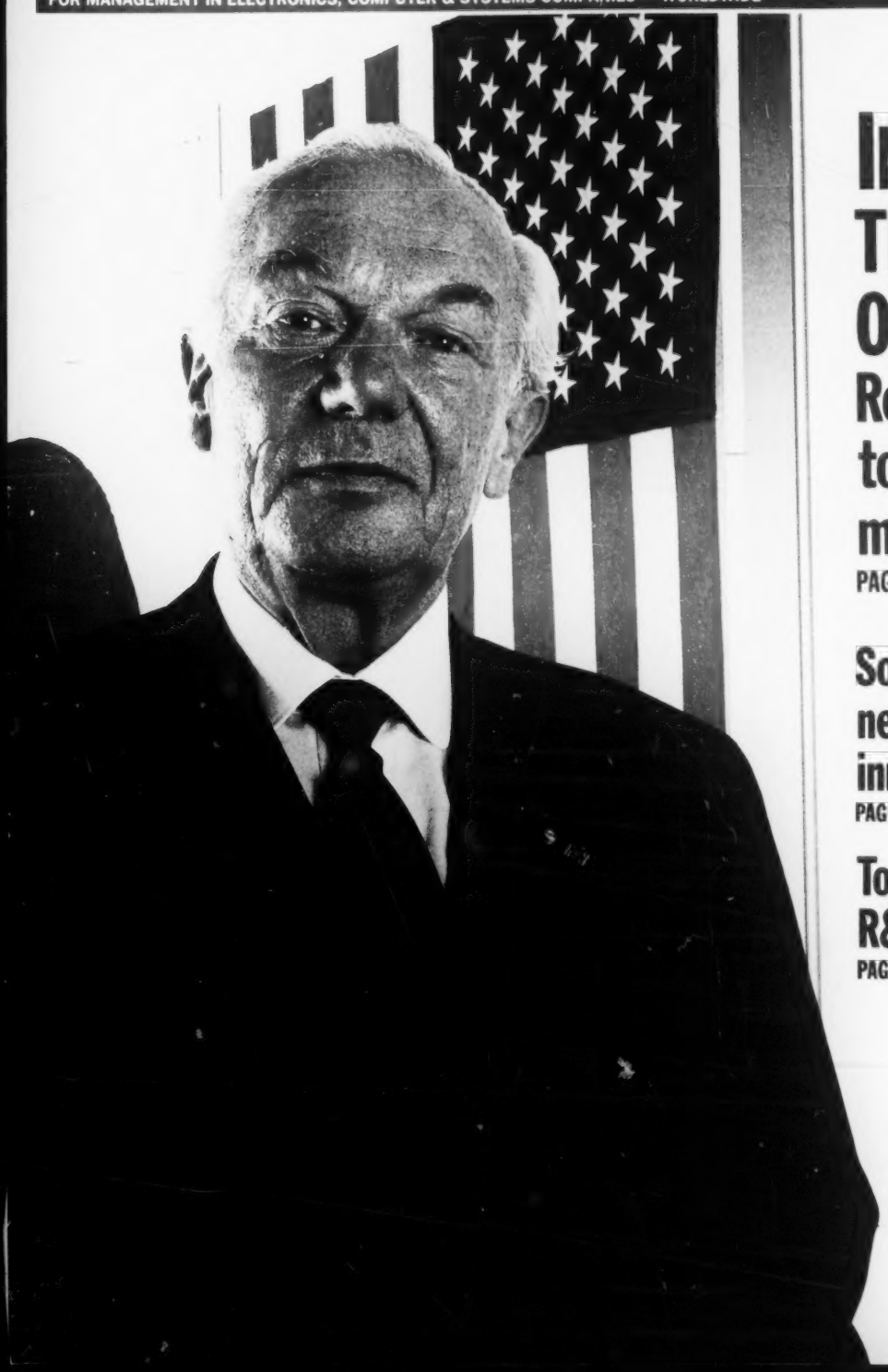
FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

AUGUST 6, 1990



INSIDE THE HOUSE OF SIEMENS

Reorganizing to open world markets

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Southern Bell's network innovations

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Karlheinz Kaske, Siemens' chairman

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 15 AUGUST 6, 1990

PAGE 28 Siemens chairman Karlheinz Kaske: No time to relax

Cover photo: Kaske by Blackstar; background model: Draw the Line Productions; background photo: Renee Fraser

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Trying to restructure an old, highly diversified $36 billion company is no easy task. But Siemens AG — Europe's third-largest company by electronics revenue — is changing and, apparently, changing for the better. Once regarded in its German homeland as a bank whose hobby was electronics, Siemens is shedding its conservatism in favor of streamlined decision-making and aggressive international expansion.

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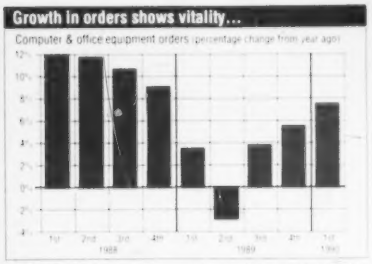

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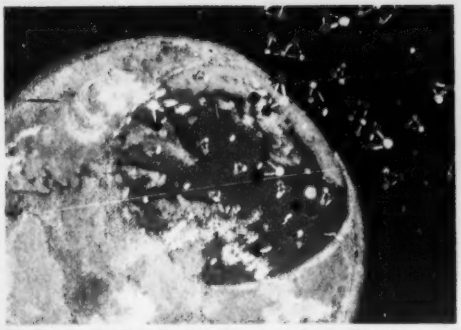

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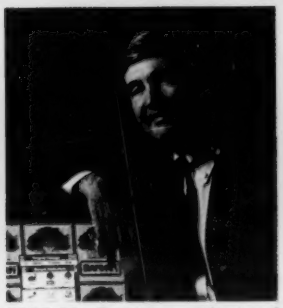

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Why Siemens made it, and Philips didn't

Barbara Berkman, London senior editor

When Europe's two largest and best-established electronics companies — not counting IBM, that is — both decided it was time to set in motion massive internal restructuring last year, the editors of Electronic Business began to get interested. And when end-of-year data showed both companies had lost hundreds of millions of dollars last year in major divisions, our interest reached a fever pitch.

In fact, not long after Philips and Siemens both announced they were throwing out their old management structures and management strategies, editor-in-chief Jeff Bairstow in the U.S. and senior editor Barbara Berkman in London scheduled flights for Eindhoven and Munich to see just how much more they could find out.

Management at Philips made the most noise about being treated unfairly by the press — but they were just as adamant about keeping most of their plans out of view. On the other hand, Siemens showed remarkable candor in describing its weaknesses and in detailing its plans for editors Bairstow and Berkman.

Our cover story on Siemens is the result. Reporting from Europe on how chairman Karlheinz Kaske set about rebuilding the antiquated 'House of Siemens' and replacing it with a market-oriented management structure, senior editor Berkman notes in an aside that while she was busy checking to see if the new House of Siemens could really stand up to the pressures of world competition, the 'restructuring" at Philips had already begun to collapse.

Berkman reports that Siemens appears to be making all the right moves for a company set on restoring its top position as a world-class competitor in the electronics industry — decentralizing decision-making in a decidedly un-Teutonic manner and finally opening the way for new, young and internationally minded managers from all over the world.

That new openness even extends to our own shores. As part of the Siemens story, San Jose editor Teri Sprackland takes an insider's look at Siemens Corp. in the United States.

The U.S. addition to the House of Siemens might better be described as still under construction, a money pit into which Siemens has poured billions of dollars with little profit so far.

And what of the Philips restructuring? Yes, Bairstow and Berkman toured Philips, too — but the reorganization they saw then is now under reconstruction itself — as is our upcoming story detailing what went wrong at the company and what's being done to repair the damage.

J. WILLIAM SEMICH, managing editor

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public sector in the wake of a recent trade agreement between the U.S. and Japan.

"We know from our discussions with Japanese scientists and engineers that there is a pent-up demand for our products in the public sector," Rollwagen says in an unusual commentary released by the Minneapolis-based company. "We believe there is at least $100 million of immediate business for our supercomputers in the public sector market."

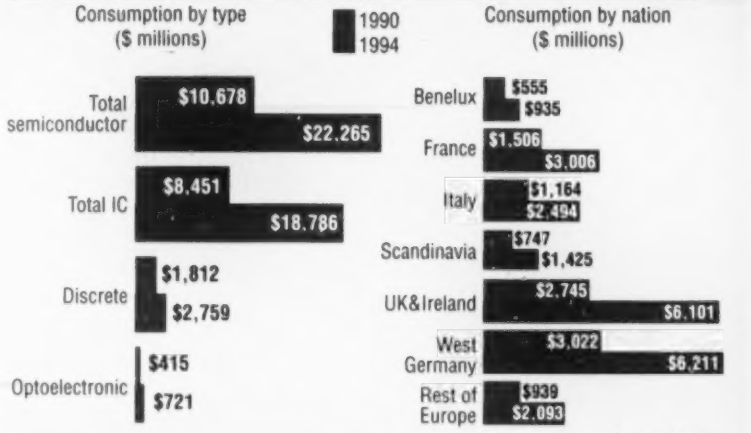
In the agreement, Japan promises to remove obstacles that have prevented U.S. supercomputer manufacturers from competing for sales to Japanese government agencies, universities and other institutions. Purchase decisions will now be based on such factors as value and performance, rather than simply the lowest bid. Performance will be based on benchmark tests of real workloads rather than peak performance tests often used by Japanese supercomputer vendors.

Rollwagen cautions, however, that it remains to be seen whether Japan will live up to the spirit of the agreement by actually buying U.S.-made supercomputers. But the CEO is encouraged by the fact that the Japanese government's 1990 budget includes "sufficient funds" for purchasing supercomputers similar to those already owned by the private sector. Cray has 17 systems installed at 15 major Japanese corporations.

RICK WHITING

Cray Research CEO John Rollwagen: Japanese public sector shows pent-up demand for supercomputers

European semiconductor demand growing rapidly



Source: Dataquest

SEMICONDUCTORS

For chipmakers, Europe proved biggest buyer

EUROPE'S APPETITE for semiconductors has proved voracious, according to recently released figures by market research firm Dataquest Europe.

By year end, semiconductor market growth will hit 10.4% in Europe, but will be negative in Japan and the United States and a paltry 6% in Asia. Market bookings for Europe in April were just 25% less than for the United States.

At its annual conference in Geneva in June, Dataquest predicted European consumption of semiconductors would reach $10.7 billion in 1990. Data-processing applications will consume 35.7% of the European semiconductors used in 1990, with growth fueled by the robust market for 80386-based personal computers and the takeoff of PC-based local area networks. Telecommunications applications will consume 19.1% of semicondustors, followed by industrial applications at 17.7% and consumer electronics at 15.5%.

There were some bright predictions for Europe's ability to take a leading role in some areas, particularly the maturing market for ASICs. Despite rapid ASIC price erosion and the rise in popularity of chip sets and standard products, Dataquest forcast that the European ASIC market, particularly for mixed analog/digital ICs, would reach $1.6 billion in 1993, with 62% of the market from standard cells, 28% from full custom cells, and 10% from programmable arrays. Dataquest forcast bad news for suppliers: gate array prices would continue to drop and market growth will slow.

Despite gains, European semiconductor producers still lag in competitiveness in such key areas as CAD tool development and commercialization of technology.

— B. B.

HARDWARE

Hitachi jumps gun on IBM mainframe cycle

THE IBM SUMMIT mainframe computer generation has started without waiting for IBM. Hitachi Ltd has started to take orders for "M-880 processor group," with shipments scheduled to start during the fourth quarter of calendar 1990.

Industry experts see the move as risky, even though Hitachi's hardware has reached the end of its life cycle. Not only Japanese customers but Hitachi Data Systems in the U.S. have been asking for updated hardware. The present M-680 product was announced more than five years ago in March 1985, one month after IBM's Sierra but eight months before Fujitsu's M-780. However, IBM kept

Banyan struggles to survive in a competitive LAN market

A reputation for technical excellence and innovation won't be enough to carry the company through the '90s

BY DWIGHT B. DAVIS

With late 1980s revenue growth averaging close to 100% a year, a technically innovative product line and a solid base of large corporate customers, Banyan Systems Inc. has established itself as a dogged competitor in the local-area-networking race. But the race has been heating up, and the Westboro, Mass. firm is struggling to avoid becoming an also-ran.

As the importance of LANs within major corporations has grown, minicomputer and mainframe vendors have introduced networking products directly competitive with the systems sold by Banyan and other PC LAN suppliers. Market leader Novell Inc. is girding for an onslaught by Microsoft Corp. and its allies, leaving analysts to question the long-term viability of second-tier Banyan.

Compounding Banyan's problems has been recent turmoil in its marketing department. During the past year, two vice presidents of marketing have left the company, reportedly at the request of president and chief executive officer David C. Mahoney. "Banyan's marketing is abysmal," says Lee Doyle, manager of LAN research at International Data Corp.

Doyle says the management turnover was a major reason Banyan dropped plans to float an initial public offering sometime this year. Mahoney now talks about an IPO occurring early in 1991.

Mahoney claims the company is successfully regrouping. James E. Allchin, Banyan's vice president and chief technical officer, is now heading all marketing activities.

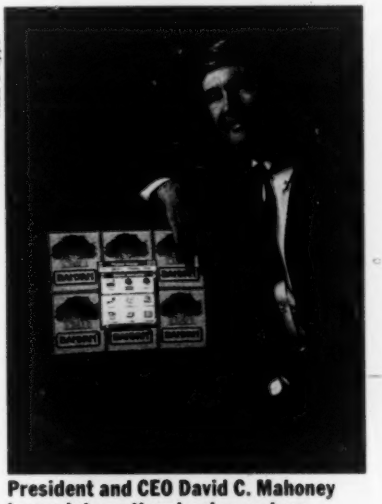
Allchin expects to hire a new marketing vice president, who will report to him. In the meantime, he says, "If poor marketing is the worst thing our critics can say about us, it's really quite flattering. There isn't a chance in hell that anybody will touch us technically."

Heading for $100 Million

Banyan ended the '80s with an enviable record of revenue growth. Sales totalled $10.6 million in 1986, $24 million in 1987, $47.2 million in 1988 and $80 million in 1989.

Growth will slow this year, with sales reaching about $100 million, Mahoney says, partly because the company will be devoting resources to bolster its network of 140 value added resellers. These VARs account for close to 75% of Banyan's sales.

The company achieved its previous growth thanks to the popularity of Vines, its Unix-based network operating system designed to connect different types of computers running different operating systems on local as well as wide-area networks. One key to Vine's success has been StreetTalk, a directory service that easily connects users to one another and to networked resources.



Webb Chappell

President and CEO David C. Mahoney hopes international sales and an "annuity" generated by its customers' future needs will fuel Banyan's growth

For years, no other LAN vendor could match Banyan's powerful directory, but early this year Novell announced a directory system that could challenge StreetTalk's dominance. If the Novell system is even equivalent to Banyan's directory, it could severely erode Banyan's technical edge, believes analyst Doyle. Mahoney rejects that threat, saying it will take years for Novell to fully integrate its directory with its broad line of existing software products.

For its target market, Banyan chose medium-sized to large corporations that need to connect hundreds or thousands of PCs as well as mainframes and minicomputers. Most of its half-million installed LAN connections reside in this kind of high-end, heterogeneous environment.

Despite its corporate penetration, though, Banyan accounted for just 5% of worldwide LAN shipments in 1989, says Doyle at IDC. The company holds about 4% of the worldwide installed base, he estimates.

As for Banyan's claim to be "the leader in corporate-wide PC networking," Doyle says, "any company can call itself a leader if it splits the market finely enough."

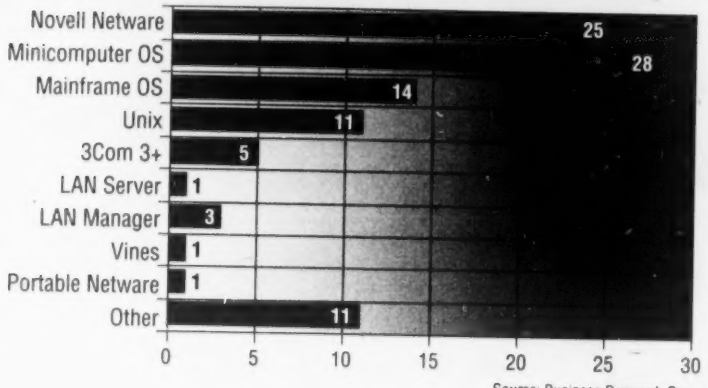
A LAN annuity

Such a market distinction has merit, argues Mahoney, because where LANs are sold is as important as how many are sold. "Most LAN network operating systems are sold in ones or twos to each customer," he says.

"Compare that to our target customers, some of whom have 60 or more copies of Vines installed," he continues. And, because Banyan sells

Which LAN for the Fortune 1000?

Survey respondents' vendor preferences for future LAN implementations
(% respondents)



Source: Business Research Group

its corporate clients many software options for Vines, Mahoney says, the per-copy selling price of Vines averages from $7,000 to $9,000. By contrast, he estimates, Novell probably averages from $800 to $1,200 per sale of its Netware operating system.

It wouldn't be unusual for a multisite Banyan customer to have 6,000 of its 18,000 corporate PCs running on a Vines network, according to Mahoney. "The remaining 12,000 PCs represent an annuity for us that other vendors don't have," he claims. This "annuity," he explained, is the likelihood that the customer will expand the Vines network as it links the remaining PCs.

Not all agree with this analysis, however. One skeptic is Kevin O'Neill, vice president of network research and consulting at the Business Research Group in Newton, Mass. "If I were Mahoney, the annuity philosophy would scare the hell out of me," he says.

O'Neill bases his caution on a recent BRG survey of 100 information system managers at Fortune 1000 firms. The survey showed a strong trend toward the use of minicomputer and mainframe operating systems for local networking functions.

The corporate market to which Banyan sells is precisely the sector that needs to better exploit its larger systems — in this case, by adding LAN operation to the systems' tasks — and also has the in-house talent to effect such a change, O'Neill says. As a result, he believes, Banyan's customers with PCs not yet networked may look to mainframe or minicomputer solutions rather than Vines when they want to link the PCs.

Allchin finds O'Neill's scenario "exceptionally unlikely." In fact, he says, "we have customers replacing minicomputers and mainframes with our networks, so we're taking share from them rather than vice versa."

International thrust

Even if Banyan's annuity doesn't pan out, the firm is pursuing another sales avenue that may prove more reliable — the overseas market. In February, the company appointed K. Wayne Fitzsimmons, formerly with Data General Corp., as vice president, international.

For years, no other vendor could match Banyan's powerful directory

International sales currently account for only about 20% of Banyan's revenue, but Mahoney expects that figure to reach between 40% and 50% by 1993. In addition to beefing up its overseas marketing operation, Banyan is once again counting on its technical expertise.

In March, the company demonstrated Multilingual Vines, an implementation that automatically displays screen menus and status messages in the native language of the network user. The first version of the system, to be shipped in the third quarter of this year, will support German, French and English on the same Vines network.

The international strategy may have merit, especially since foreign markets represent relatively virgin territory for LAN vendors, says O'Neill at BRG. "Banyan may be able to sustain its growth and profitability on the back of European sales," he says.

On the domestic front, Banyan has been touting a "cooperative alliance" with Redmond, Wash.-based Microsoft, under which the two firms will work to ensure that Microsoft's LAN Manager networking system and Vines can interoperate. Banyan also has announced its plans to support Microsoft's OS/2 operating system as well as the recently debuted Windows 3.0 graphical operating environment.

Many observers, though, question the significance of the Microsoft relationship. "Microsoft is working with a lot of people," O'Neill notes, and analyst Doyle says the claims made for the alliance are simply "bull."

On the other hand, Doyle does find merit to Banyan's "trade-in" program, announced this May. Under the program, customers who currently use Novell's Netware, 3COM Corp.'s 3+Share, or one of several other LANs can receive credits ranging from $695 to $3,500 if they trade in their systems for a Vines network.

"The trade-in program is an interesting and positive move on Banyan's part," says Doyle.

Whether Banyan's multi-faceted strategy will be enough to survive the forthcoming LAN slug-fest remains to be seen. Further clouding the picture is a growing consensus that the LAN industry is likely to experience some consolidation.

O'Neill believes Banyan is a likely takeover candidate by any medium-sized to large computer systems vendor that needs a LAN capability.

CEO Mahoney agrees that the industry will see more consolidation, and says, "Banyan is as attractive a candidate for acquisition as any other company. But we're confident of the market opportunities available to us, and we're not shopping for a suitor." □

R&D spending grew in 1989 even though profits plummeted

Last year saw a healthy 10.6% rise in spending for the top 100 electronics R&D spenders; don't expect any improvement in 1990

BY BRUCE C.P. RAYNER AND LINDA STALLMANN

As a group, the top 100 U.S. electronics R&D spenders had a disappointing 1989. Sales growth was a mediocre 7%, and profits plummeted by 26%. But in the face of poor performance, these top 100 companies steadfastly held a course for future growth. Research and development spending rose by 10.6%, from $18.2 billion in 1988 to $20.1 billion last year.

And because sales grew at a slower rate than R&D, R&D spending as a percent of sales increased from 8.7% in 1988 to 9.3% last year — nearly three times the national average of 3.2% for all industries, according to the National Science Foundation.

The top electronics R&D spender, ranked in terms of percentage of sales, was Ashton-Tate Corp. at a hefty 25.9%. Despite a sales setback, Ashton-Tate increased its R&D spending by 29.9% to $68.7 million.

Because product development is their major activity, software companies spend more on R&D than any other segment of the electronics industry. Even so, the nine software companies on this year's list spent an average of 13.2% of their sales on R&D, down from a 15.0% rate for the top software companies on last year's list.

Close on the heels of Ashton-Tate was Cypress Semiconductor Corp. with a 23.9% R&D spending rate. The static RAM maker also topped this year's ELECTRONIC BUSINESS fastest-growing company list [ELECTRONIC BUSINESS, April 30, 1990 p34.] To stay ahead in the highly competitive semiconductor game, Cypress has kept its R&D rate consistently above 20% for the last five years. So far, the heavy spending has paid off. Cypress's annual sales and profit growth in 1989 were 43.0% and 47.5%, respectively.

Cypress was among 15 top R&D performers that made their debut on this year's list. Other first-time top performers include KLA Instruments (no. 11) with a 15.2% of sales R&D rate, Teradata (no. 15) with 13.8%, Tellabs (no. 23) with 13.1%, and Network Equipment Technologies (no. 30) with 11.6%. To qualify for the ELECTRONIC BUSINESS R&D ranking, companies must be U.S.-based, publicly traded, derive at least 70% of their revenue from electronics-related sales and be included in the ELECTRONIC BUSINESS 200 listing.

Focus on R&D

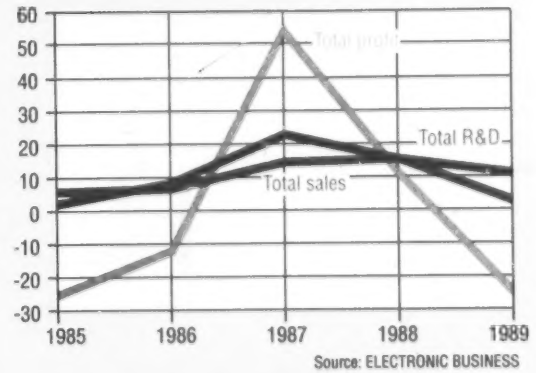
Besides Cypress, two other stellar performers cashing in on their high R&D spending are fellow semiconductor makers Integrated Device Technology Inc. (no. 5) and Chips & Technologies Inc.(no. 9). Like Cypress, both Silicon Valley companies spend over 15% of their sales on R&D and both had sales and profit growth above 40% in 1989. In total the nine semiconductor makers on this year's list averaged an R&D spending rate of 9.9% of sales.

Chips & Technologies led the list of top R&D spenders per employee. The reason, says Keith Lobo, executive vice president and chief operating officer of the five-year-old company, is that Chips & Technologies is and always has been a fabless semiconductor company that focuses on product development and marketing. In total, 60% of its employees are engaged in some type of R&D work. "It's the nature of our business," says Lobo.

When it comes to annual R&D spending growth, not even these three IC makers can hold a candle to Conner Peripherals (no. 85). The three-year-old disk drive maker saw its R&D spending grow by a whopping 360% last year thanks

R&D trending down

Annual percentage change for the top 100 ELECTRONIC BUSINESS R&D spenders



Source: ELECTRONIC BUSINESS

What's in store for R&D in 1990? As sales and profit growth drops so will R&D growth

Top U.S. R&D spenders

Total R&D spending

	$ millions	% of revenue
IBM	6,827.0	10.9
Digital Equipment	1,525.1	12.0
Hewlett-Packard	1,269.0	10.7
Xerox	809.0	6.5
Motorola	784.0	8.1
Unisys	781.5	7.7
GM Hughes	592.3	5.2
Texas Instruments	506.0	7.8
NCR	446.0	7.5
Apple Computer	420.1	8.0
Intel	365.1	11.7
Honeywell	283.5	4.7
Amdahl	277.3	13.2
National Semiconductor	264.8	T6.1
AMP	253.0	9.0

Fiscal 1989 figures

R&D spending growth

(Percentage change fromfiscal 1988)

Conner Peripherals	360.7%
Novell	167.3%
Dell Computer	137.8%
Micron Technology	130.0%
VLSI Technology	120.2%
Oracle Systems	104.5%
KLA Instruments	82.9%
Chips and Technologies	79.1%
Compaq Computer	77.0%
Bolt Beranek and Newman	68.1%
Sun Microsystems	67.3%
Applied Materials	66.3%
Network Equipment	64.3%
Integrated Device	64.3%
3Com	63.9%

R&D spending per employee

Chips and Technologies	$67,373
Ashton-Tate	48,008
Lotus Development	37,737
Cypress Semiconductor	34,297
Amdahl	33,817
Quantum	31,646
Cray Research	30,448
Apple Computer	28,937
Microsoft	27,302
Applied Materials	27,271
KLA Instruments	25,315
Mentor Graphics	24,075
VLSI Technology	23,480
Sun Microsystems	22,934
Tandem Computers	21,315

Source: Company reports, ELECTRONIC BUSINESS

to four new product introductions. "We are in the business to make money," says Carl Neun, Conner's chief financial officer, "and the only way to fuel growth is through R&D spending."

Second to Conner in terms of R&D spending growth last year was Novell Inc. (no. 39) with a growth rate of 167%. That high rate of growth took the communications software company from a previous R&D spending average of 6% of sales to 10% with the expectation that R&D spending will rise to 12% in 1990, says Peter Troop, Novell's director of corporate market relations. "The reality is that R&D is crucial to the business," says Troop.

While the individual performance of Conner and Novell are laudable, it is, of course, the big spenders that exert the most influence on the averages. Last year, as in years past, the biggest spender in dollar terms was IBM Corp. (no. 32). Big Blue spent $6.8 billion on research and development up 15.2% from 1988. The computer giant accounts for 34% of the top 100 companies' total R&D spending. In fact, the 10 largest R&D spenders combined account for 69% of total spending by the top 100.

Can the electronics industry maintain a double-digit growth rate through the early 1990s even though profitability is under fire? For growth companies like Cypress, the answer may be yes, but for the electronics industry at large, the prospects are less certain.

Some experts believe an R&D slowdown is already in the making. On the one hand, R&D spending is driven by sales and profit performance from the previous year and by current sales and profit expectations, says John Jankowski, an analyst at the National Science Foundation in Washington, D.C. On the other hand, he adds, companies know they need to spend heavily on product development in order to stay competitive.

While those factors influence R&D spending, Jankowski believes short-term sales and profits exert the strongest influence. Because of the R&D 100's lackluster 1989 revenue and profit performance, don't expect any significant aggregate R&D growth for these companies in 1990.

Top U.S. R&D spenders

R&D as a percentage of revenue

Ashton-Tate	25.9%
Cypress Semiconductor	23.9%
Cray Research	18.3%
Advanced Micro Devices	18.3%
Integrated Device Technology	17.1%
Lotus Development	17.0%
VLSI Technology	16.2%
National Semiconductor	16.1%
Chips and Technologies	15.4%
Analog Devices	15.2%
KLA Instruments	15.2%
GenRad	14.7%
Applied Materials	14.4%
Digital Communications	14.3%
Teradata	13.8%

Source: ELECTRONIC BUSINESS

Stretching R&D dollar

But there are still several ways for managers to stretch the R&D dollar. For many high-technology companies, getting the ideas out of the lab are just as important as having the ideas in the first place. Improving time to market, adopting concurrent engineering and simply managing R&D more efficiently are becoming crucial for success.

Partnering R&D is one way to boost the impact of limited R&D dollars. Fabless IC designer Chips & Technology focuses its own R&D efforts on design and leaves the process technology development to its chip-making partners. Predicts Chips & Technology's Lobo: "There will be a lot more R&D sharing in the future." □

Top U.S. R&D spenders

Rank 1989	Rank 1988	Company	R&D as a percentage of revenue	Total R&D expenditures ($ millions)	Change from 1988	Fiscal 1989 revenue ($ millions)	Change from 1988	Fiscal 1989 net income ($ millions)	Change from 1988	Fiscal year ended
1	6	**Ashton-Tate**	25.9%	68.7	29.9%	265.3	-13.7%	-28.6	NM	12/89
2	—	**Cypress Semiconductor**	23.9%	47.6	41.4%	199.3	43.0%	30.7	47.5%	12/89
3	7	**Cray Research**	18.3%	143.3	21.7%	784.7	3.8%	89.0	-43.1%	12/89
4	3	**Advanced Micro Devices**	18.3%	201.8	-3.2%	1,104.6	-1.9%	46.1	138.4%	12/89
5	8	**Integrated Device Technology**	17.1%	30.8	64.3%	180.7	49.2%	17.9	54.9%	3/89
6	5	**Lotus Development**	17.0%	94.3	12.5%	556.0	18.7%	68.0	15.3%	12/89
7	40	**VLSI Technology**	16.2%	46.7	120.2%	288.5	30.4%	0.5	-92.5%	12/89
8	27	**National Semiconductor**	16.1%	264.8	-5.5%	1,647.9	-33.3%	-205.5	NM	5/89
9	15	**Chips and Technologies**	15.4%	33.6	79.1%	217.6	53.8%	33.0	49.5%	6/89
10	11	**Analog Devices**	15.2%	68.9	13.9%	453.4	3.2%	27.9	-26.6%	10/89
11	—	**KLA Instruments**	15.2%	25.1	82.9%	165.5	46.6%	11.7	32.3%	6/89
12	10	**GenRad**	14.7%	27.7	-9.7%	188.9	-8.2%	-6.1	NM	12/89
13	21	**Applied Materials**	14.4%	72.3	66.3%	501.8	38.3%	51.5	28.6%	10/89
14	28	**Digital Communications**	14.3%	29.8	16.1%	208.2	-8.5%	17.7	-58.0%	6/89
15	—	**Teradata**	13.8%	18.9	59.1%	137.4	53.6%	9.9	17.1%	6/89
16	22	**Microsoft**	13.7%	110.2	58.0%	803.5	36.0%	170.5	37.6%	6/89
17	29	**Mentor Graphics**	13.4%	50.9	50.7%	380.0	26.4%	44.8	33.6%	12/89
18	13	**Sun Microsystems**	13.3%	234.1	67.3%	1,765.4	67.9%	60.8	-8.4%	6/89
19	12	**Teradyne**	13.2%	64.0	3.3%	483.6	4.6%	10.2	NM	12/89
20	24	**Stratus Computer**	13.2%	45.1	47.7%	341.3	28.7%	35.4	20.6%	12/89
21	9	**Tektronix**	13.2%	189.2	-12.2%	1,433.0	1.5%	18.9	NM	5/89
22	17	**Amdahl**	13.2%	277.3	25.5%	2,101.1	16.6%	153.0	-28.5%	12/89
23	—	**Tellabs**	13.1%	23.7	34.2%	181.3	16.6%	7.1	-47.6%	12/89
24	19	**Data General**	13.0%	171.4	3.8%	1,314.4	-3.7%	-119.7	NM	9/89
25	25	**Computer Associates**	13.0%	133.5	63.8%	1,030.2	45.3%	163.5	60.6%	3/89
26	16	**Tandem Computers**	12.5%	203.5	20.2%	1,632.5	24.2%	118.3	25.2%	9/89
27	26	**Digital Equipment**	12.0%	1,525.1	16.7%	12,742.0	11.0%	1,072.6	-17.8%	6/89
28	—	**Silicon Graphics**	11.9%	31.4	29.8%	263.8	72.9%	11.5	-5.9%	6/89
29	31	**Intel**	11.7%	365.1	14.7%	3,126.8	8.8%	391.0	-13.7%	12/89
30	—	**Network Equipment Technologies**	11.6%	15.9	64.3%	136.7	51.0%	16.0	34.4%	3/89
31	18	**Concurrent Computer**	11.6%	32.3	0.9%	278.0	5.7%	-24.7	NM	6/89
32	37	**IBM**	10.9%	6,827.0	15.2%	62,710.0	5.1%	3,758.0	-31.6%	12/89
33	20	**General DataComm**	10.8%	21.6	-7.0%	201.2	4.7%	-9.0	NM	9/89
34	35	**Hewlett-Packard**	10.7%	1,269.0	24.5%	11,899.0	21.0%	829.0	1.6%	10/89
35	30	**Intergraph**	10.6%	91.5	2.6%	860.1	7.5%	79.5	-9.6%	12/89
36	51	**Burr-Brown**	10.6%	18.0	22.7%	169.5	-4.1%	8.7	-24.6%	12/89
37	33	**Coherent**	10.5%	21.3	8.1%	201.6	7.2%	8.6	NM	9/89
38	14	**DSC Communications**	10.2%	43.9	-2.3%	429.7	26.5%	34.2	70.7%	12/89
39	74	**Novell**	10.1%	42.8	167.3%	421.9	50.1%	48.5	59.5%	10/89
40	43	**3Com**	9.9%	38.4	63.9%	385.9	53.1%	34.3	52.2%	5/89
41	36	**Westmark Int'l.**	9.8%	43.1	14.2%	438.8	20.1%	19.1	82.6%	12/89
42	42	**Dynatech**	9.8%	39.2	13.8%	399.5	8.6%	18.6	-24.1%	3/89
43	38	**LSI Logic**	9.6%	52.5	41.9%	546.9	44.3%	-24.9	NM	12/89
44	47	**AMP**	9.0%	253.0	6.3%	2,796.6	3.6%	280.9	-12.0%	12/89
45	45	**Oracle Systems**	9.0%	52.6	104.5%	583.7	106.9%	81.8	90.7%	5/89
46	41	**Cipher Data Products**	9.0%	19.6	12.6%	217.8	17.5%	12.2	16.5%	6/89
47	—	**Beckman Instruments**	8.9%	70.3	13.6%	785.9	2.0%	41.9	-1.4%	12/89
48	52	**Medtronic**	8.9%	66.0	24.2%	741.7	13.5%	97.4	12.6%	4/89
49	39	**ADC Telecommunications**	8.8%	17.4	-0.2%	196.4	9.2%	16.4	-3.2%	10/89
50	58	**Storage Technology**	8.7%	85.7	27.0%	982.5	12.4%	36.4	-17.6%	12/89

NM = Not meaningful. The company lost money in the base year

(Continued)

Top U.S. R&D spenders.

Rank 1989	Rank 1988	Company	R&D as a percentage of revenue	Total R&D expenditures ($ millions)	Change from 1988	Fiscal 1989 revenue ($ millions)	Change from 1988	Fiscal 1989 net income ($ millions)	Change from 1988	Fiscal year ended
51	48	**Western Digital**	8.7%	86.4	27.5%	992.1	29.1%	34.3	-20.1%	6/89
52	44	**Control Data**	8.5%	249.9	-25.6%	2,934.5	-19.1%	-680.4	NM	12/89
53	55	**Wang Laboratories**	8.5%	243.4	-1.1%	2,868.8	-6.5%	-320.6	NM	6/89
54	84	**Bolt Beranek and Newman**	8.4%	24.6	68.1%	291.6	-4.5%	-31.5	NM	6/89
55	34	**Fluke**	8.3%	20.6	-12.2%	247.7	10.3%	23.2	86.4%	9/89
56	61	**Diasonics**	8.3%	16.1	-20.9%	194.2	-31.0%	-21.5	NM	12/89
57	53	**Motorola**	8.1%	784.0	17.9%	9,620.0	16.6%	498.0	11.9%	12/89
58	57	**Applied Magnetics**	8.1%	25.4	12.1%	314.1	7.2%	1.2	-95.1%	9/89
59	—	**Quantum**	8.1%	16.8	39.3%	208.0	10.3%	12.9	NM	3/89
60	66	**Apple Computer**	8.0%	420.1	54.2%	5,284.0	29.8%	454.0	13.4%	9/89
61	49	**Perkin-Elmer**	7.8%	61.6	-37.5%	784.3	-32.7%	46.9	-21.9%	7/89
62	56	**Texas Instruments**	7.8%	506.0	2.4%	6,521.9	3.6%	291.7	-20.4%	12/89
63	62	**Unisys**	7.7%	781.5	9.6%	10,096.9	2.0%	-639.3	NM	12/89
64	54	**Micropolis**	7.6%	23.4	-17.4%	307.3	-13.0%	-49.8	NM	12/89
65	60	**Measurex**	7.6%	21.7	13.0%	285.3	7.6%	40.7	9.8%	11/89
66	—	**Valid Logic Systems**	7.5%	13.1	-15.1%	173.9	23.2%	10.0	29.2%	12/89
67	63	**NCR**	7.5%	446.0	7.1%	5,956.0	-0.6%	412.0	-6.2%	12/89
68	59	**Dataproducts**	7.4%	26.1	-2.1%	353.4	2.4%	3.8	NM	3/89
69	—	**BancTec**	7.2%	8.9	32.9%	123.5	32.3%	7.7	19.5%	3/89
70	50	**Ask Computer Systems**	7.2%	13.4	13.0%	186.3	30.8%	13.5	25.0%	6/89
71	80	**Wyse Technology**	7.2%	32.5	34.7%	452.3	-0.9%	-21.2	NM	3/89
72	71	**M/A-COM**	7.0%	31.0	23.9%	441.1	4.0%	0.2	-99.0%	9/89
73	--	**Archive**	6.8%	12.4	62.7%	181.4	47.9%	15.3	58.2%	9/89
74	67	**Gerber Scientific**	6.7%	20.2	17.8%	299.3	13.4%	32.9	10.9%	4/89
75	46	**Maxtor**	6.7%	23.5	-1.7%	351.0	29.4%	5.2	-63.1%	3/89
76	64	**Xerox**	6.5%	809.0	1.9%	12,431.0	8.3%	488.0	568.5%	12/89
77	—	**Intermec**	6.3%	8.3	17.1%	131.1	40.0%	8.0	64.6%	3/89
78	65	**Varian Associates**	6.2%	83.1	3.6%	1,343.6	14.8%	31.5	13.5%	9/89
79	76	**Esterline**	6.1%	17.4	7.9%	284.2	-0.1%	7.9	-6.1%	10/89
80	69	**Watkins-Johnson**	6.0%	18.5	1.0%	310.7	6.3%	18.7	-9.1%	12/89
81	86	**Atari**	5.8%	24.6	15.2%	423.6	-6.3%	4.0	-89.8%	12/89
82	89	**Loral**	5.7%	67.1	4.7%	1,187.0	-17.6%	60.3	-18.9%	3/89
83	77	**Andrew**	5.6%	17.0	20.5%	301.9	19.1%	16.2	16.8%	9/89
84	70	**Scientific-Atlanta**	5.6%	30.8	2.5%	546.8	7.5%	36.3	22.3%	6/89
85	100	**Conner Peripherals**	5.6%	39.7	360.7%	704.9	174.7%	41.4	109.7%	12/89
86	79	**Molex**	5.2%	29.9	12.3%	571.9	13.8%	57.7	-2.7%	12/89
87	83	**GM Hughes Electronics**	5.2%	592.3	7.5%	11,359.0	1.0%	632.4	-0.3%	7/89
88	72	**Everex Systems**	5.2%	19.4	24.5%	377.3	41.4%	21.3	102.3%	7/89
89	—	**Dell Computer**	5.0%	16.9	137.8%	338.6	31.3%	5.1	-64.6%	1/90
90	—	**Micron Technology**	4.8%	21.4	130.0%	446.4	48.6%	106.1	8.3%	8/89
91	78	**Harris**	4.7%	104.0	-11.0%	2,213.6	5.4%	116.2	77.7%	6/89
92	88	**Honeywell**	4.7%	283.5	-12.3%	6,058.6	-15.2%	550.3	NM	12/89
93	98	**Compaq Computer**	4.6%	132.5	77.0%	2,876.1	39.2%	333.3	30.6%	12/89
94	92	**Kollmorgen**	4.6%	10.4	-27.9%	227.8	-33.9%	-18.9	NM	12/89
95	97	**Genicom**	4.4%	11.2	5.7%	256.9	-11.9%	-24.3	NM	12/89
96	73	**TIE/communications**	4.1%	9.1	-37.4%	223.1	-12.6%	-69.8	NM	12/89
97	94	**Seagate Technology**	3.7%	51.1	2.1%	1,371.6	9.1%	0.3	-99.5%	6/89
98	95	**AST Research**	3.7%	16.9	8.0%	456.5	10.6%	-7.5	NM	6/89
99	91	**International Rectifier**	3.7%	7.2	-6.8%	195.2	9.3%	-12.7	NM	6/89
100	—	**General Instrument**	3.6%	46.9	24.9%	1,304.7	12.9%	85.5	29.2%	2/89

NM = Not meaningful. The company lost money in the base year

(Continued)

Top U.S. R&D spenders by industry segment

Fiscal year 1989 R&D expenditures

Communications

	Total ($ millions)
Motorola	$784.0
General Instrument	46.9
DSC Communications	43.9
Dynatech	39.2
3Com	38.4
Scientific-Atlanta	30.8
Digital Communications	29.8
Tellabs	23.7
General DataComm	21.6
ADC Telecommunications	17.4
Andrew	17.0
Network Equipment Technologies	15.9
TIE/communications	9.1
Segment total	**$1,117.6**

Components

AMP	$253.0
General Instrument	46.9
Molex	29.9
Burr-Brown	18.0
Segment total	**$347.7**

Computer-based systems

Perkin-Elmer	$61.6
Measurex	21.7
Coherent	21.3
Gerber Scientific	20.2
BancTec	8.9
Intermec	8.3
Segment total	**$141.9**

Desktop

Hewlett-Packard	$1,269.0
Apple Computer	420.1
Sun Microsystems	234.1
Compaq Computer	132.5
Intergraph	91.5
Wyse Technology	32.5
Silicon Graphics	31.4
Everex Systems	19.4
AST Research	16.9
Dell Computer	16.9
Segment total	**$2,264.3**

Diversified

IBM	$6,827.0
NCR	446.0
Honeywell	283.5
Control Data	249.9
Harris	104.0
Varian Associates	83.1
Segment total	**$7,993.5**

Fiscal year 1989 R&D expenditures

Government

	Total ($ millions)
GM Hughes Electronics	$592.3
Texas Instruments	506.0
Harris	104.0
Loral	67.1
Varian Associates	83.1
M/A-COM	31.0
Bolt Beranek and Newman	24.6
Watkins-Johnson	18.5
Segment total	**$1,426.6**

Instruments & measurement

Hewlett-Packard	$1,269.0
Honeywell	283.5
Tektronix	189.2
Teradyne	64.0
Perkin-Elmer	61.6
GenRad	27.7
KLA Instruments	25.1
Fluke	20.6
Esterline	17.4
Segment total	**$1,957.9**

Mainframes

IBM	$6,827.0
Unisys	781.5
NCR	446.0
Amdahl	277.3
Control Data	249.9
Cray Research	143.3
Teradata	18.9
Segment total	**$8,744.0**

Medical

Beckman Instruments	$70.3
Medtronic	66.0
Westmark Int'l	43.1
Diasonics	16.1
Segment total	**$195.5**

Minicomputers

Digital Equipment	$1,525.1
Wang Laboratories	243.4
Tandem Computers	203.5
Data General	171.4
Stratus Computer	45.1
Concurrent Computer	32.3
Segment total	**$2,220.9**

Fiscal year 1989 R&D expenditures

Peripherals

	Total ($ millions)
Western Digital	$86.4
Storage Technology	85.7
Seagate Technology	51.1
Conner Peripherals	39.7
Wyse Technology	32.5
Dataproducts	26.1
Applied Magnetics	25.4
Maxtor	23.5
Micropolis	23.4
Cipher Data Products	19.6
Everex Systems	19.4
Quantum	16.8
Archive	12.4
Genicom	11.2
Segment total	**$473.3**

Semiconductors

Motorola	$784.0
Texas Instruments	506.0
Intel	365.1
National Semiconductor	264.8
Advanced Micro Devices	201.8
Western Digital	86.4
Analog Devices	68.9
LSI Logic	52.5
Cypress Semiconductor	47.6
VLSI Technology	46.7
Chips and Technologies	33.6
Integrated Device Technology	30.8
Micron Technology	21.4
Burr-Brown	18.0
International Rectifier	7.2
Segment total	**$2,534.7**

Software

Computer Associates	$133.5
Microsoft	110.2
Lotus Development	94.3
Ashton-Tate	68.7
Oracle Systems	52.6
Mentor Graphics	50.9
Novell	42.8
Ask Computer Systems	13.4
Valid Logic Systems	13.1
Segment total	**$579.5**

Source: ELECTRONIC BUSINESS

Dealers choice: Taking workstations commercial

1990 could be the year that workstation vendors invade the retail dealer channel in force. But that's not going to be so easy

BY RICK WHITING

Plummeting workstation prices, widespread user acceptance of Unix and OS/2's slow market growth are giving workstation vendors an opportunity to sell through retail dealers — a channel long dominated by personal computers.

Original equipment manufacturers (OEMs) and value-added resellers (VARs) will account for the vast majority of indirect workstation sales through the mid-1990s. But observers say workstation vendors must begin to cultivate a dealer channel this year or risk losing a strategic advantage.

"If this channel is not firmly in place by at least the end of 1990, workstations' entry into the personal productivity market will be delayed, vendor growth rates will suffer, and OS/2 will have established an even greater head start," warns a 1989 report prepared by the Boston-based Summit Strategies consulting firm.

Workstation vendors "should have been doing it a year or two ago," says Summit president Thomas Kucharvy.

The report estimates that some 250 dealers, mostly non-storefronts, already sell workstations and predicts this will increase to 3000 — more than one-third of all dealers — by the end of 1993. "There is no question," the report says, "but that a large number of traditional PC resellers will eventually sell and support Unix workstations."

Escaping the technical niche

The dealer channel will be vital if workstation vendors intend to break out of narrow technical applications, which still account for 85% of all workstation sales, and attract commercial customers.

Vendors may have no choice but to consider dealers. As workstation prices fall below $5,000 and profit margins become razor thin, companies are finding it increasingly difficult to make a profit on direct sales. "PC vendors have proven that you just cannot sell $5,000 boxes direct and make any money," says Frank Lynn of the Chicago consulting firm Frank Lynn & Associates Inc.

Price erosion is also drying up other distribution channels. Because of shrinking profit margins many workstation OEMs, such as Interleaf Inc. and Cimlinc Inc., have stopped reselling hardware and become software-only vendors.

Sun Microsystems Inc. shipped about 95,000 workstations in 1989. The company could ship 150,000 units this year and annual sales of 500,000 workstations may not be far off. "If they're going to sell in those volumes, they're going to have to go retail," asserts International Data Corp. analyst David Card.

Workstation peddlers also may be forced into the dealer channel to counteract the intrusion of high-end personal computers into traditional workstation markets. PCs from such companies as Everex Systems Inc. and Arche Technologies Inc., based on Intel Corp.'s 80386 and 80486 microprocessors, are stealing away workstation sales at the low end.

"We're seeing that convergence of workstations and high-end PCs," acknowledges Curt Fisher, tactical marketing director for Sun Microsystems Inc. Arche Technologies president Isaac Levanon goes a bit further: "One day (workstation vendors) are going to realize that high-end PCs are eating their lunch," he says.

Failed early efforts

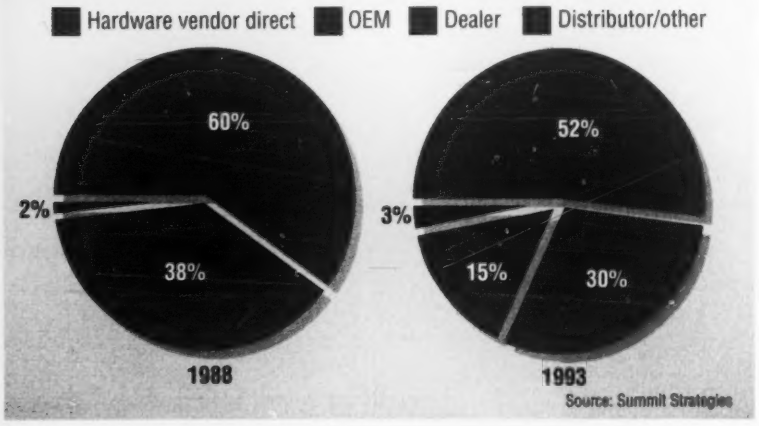
Some workstation companies have tried and failed to market their systems through dealers. As early as 1987, Apollo Computer Inc. signed up resellers who bundled Apollo workstations with third-party CAD/

The low end is rising

Market share of workstations according to price

Growth in the dealer channel

Distribution of workstations to end-users



CAM applications.

But such early efforts barely got off the ground. "They didn't know how to do it," says Robert McNeel, president of Robert McNeel & Associates Inc. in Seattle, a participant in the Apollo program. "They changed it once a month" and then it faded out, he says. "It wasn't a big part of our revenue." PCs from Hewlett-Packard Co. currently make up the bulk of McNeel's sales.

The climate for entering the dealer channel is more favorable today, however. In addition to becoming more affordable, workstations are becoming easier to use by non-technical professionals by way of standard graphical user interfaces. More commercial software is being ported to workstations, as evidenced by Lotus Development Corp.'s recent alliance with Sun. And as Unix standardizes, the dream of shrink-wrapped software for the operating system is becoming reality.

Reluctant vendors

Just how much vendor interest is there in making a serious effort to enter the dealer channel? And what strategies could vendors pursue to make a dealer channel bid successful?

Scott McNealy, Sun Microsystems president, chief executive and chairman, acknowledges that the question of selling through dealers is "a raging debate," but says that an attempt to enter the retail dealer channel is not in his company's immediate future.

Fisher says that Sun would still require dealers to add value to workstations they sell, rather than just sell computers in volume as many PC retailers do. McNealy says that manufacturers would also have to offer dealers steeper discounts.

Nevertheless, the Summit report predicts that Sun will make a broad distribution agreement with a major dealer chain this year. Sun could be laying the foundations for a dealer network through its stable of some 300 value-added resellers, which includes dealer-like VARs like Dataphaz Inc., a ComputerLand franchisee, and Entre Computer Centers.

HP is selling workstations through "small, vertically oriented dealers," particularly in the CAD/CAM market, according to Pierre Bouchard, product line manager for HP's entry-level DN2500 workstation. But HP is relying largely on distributors to tap into the small reseller channel.

Next Inc. signed a deal with Businessland Inc. in June 1989 giving the dealer chain exclusive rights to market the Next workstation for commercial applications. But sales have gotten off to a slow start and sources say that Businessland may not attain its goal of selling 15,000 units in the first year. Nevertheless, Businessland, which has been evolving from a dealer into a systems integrator, is reported to be mulling a deal to carry IBM's RS/6000 workstation line.

Although workstations are becoming easier to install and operate, they still require more training and support than PCs and some observers question whether dealers are up to the task. Any vendor that wades into the dealer channel must be ready with sound training and support programs for dealers and end-users.

Fisher says that designing workstations to make them easier to operate and service would reduce the amount of support workstations require and make them more attractive to low-end resellers and customers. "You can't ask someone to buy a $4,000 workstation and expect them to buy $2,000 of support with it," he says.

Avoiding channel conflict will also be crucial, says the Summit report. Vendors that jump into the dealer channel too quickly risk creating conflict with existing channels. Because traditional distribution channels will still account for 70% of workstation unit sales through 1993, too much emphasis on dealers could result in overdistribution, declining loyalty among resellers, price erosion and inadequate user support.

Robert McNeel is skeptical about the amount of user interest in buying workstations through dealers. He believes that a small-but-vocal group of Unix enthusiasts is making the potential retail market appear larger than it really is.

And workstation manufacturers also may be opening the door to a wave of clones and the resulting competition and price erosion the PC industry saw in the early 1980s.

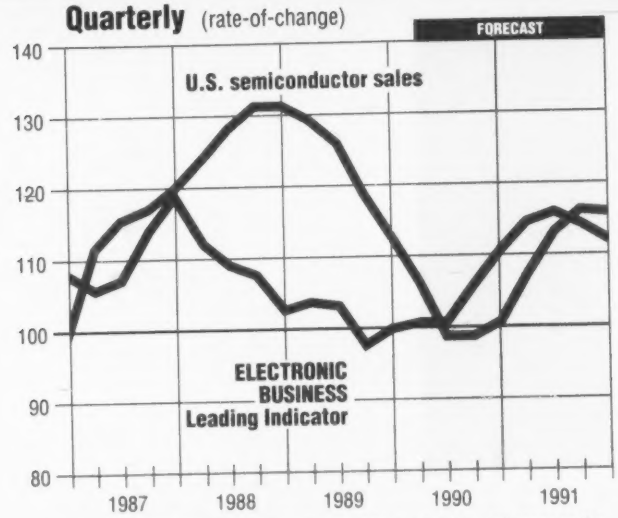
Consultant Lynn, who advised IBM on distribution when it began marketing the original PC, suggests that workstation manufacturers create an entirely new distribution channel. He envisions a "hybrid channel" with some characteristics of VARs and value-added distributors but with the hardware focus of dealers.

Lynn says the channel could be built using existing resellers or even by creating new resellers through franchises using outside capital. As an analogy, he points to the Japanese car maker Nissan, which signed up new dealers to sell the Infiniti line of luxury cars.

Lynn believes that the battle for domination of the desktop between workstations and PCs will be won or lost through low-end distribution. And the stakes are very high. "It's not going to be fought with nickels and dimes," he says. "There are going to be big winners and probably some big losers as well." □

ELECTRONIC BUSINESS Leading Indicator

Quarterly (rate-of-change)



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Spiller at Cahners Publishing Company, 275 Washington St., Newton, MA 02158-1630, USA, telephone (617) 558-4397, fax (617) 558-4402.

Monthly (rate-of-change)

The ELECTRONIC BUSINESS Leading Indicator inched up from a revised 99.6 in April to 100.8 this past May. This slight increase was fueled both by strong increases in the semiconductor stock price and semiconductor bookings. The stock price increased from 67.8 (1970=10) in April to 74.6 this past May, the highest it has been since August 1987. Semiconductor bookings also strengthened from $1.279 billion in April to $1.380 billion this past May. The EBLI is forecast to increase steadily over the next year and reach a peak of 116 in June, 1991.

Source: Cahners Economics

Electronics industry indicators this month

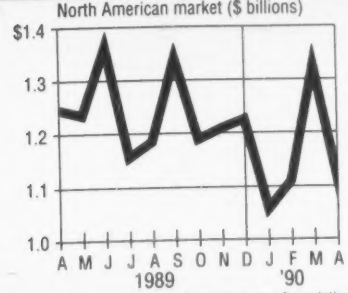
	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate-of-change, Apr.)	100.8	99.6	103.0	100.9
U.S. semiconductor bookings ($ millions, 3-month average, Apr.)	$1,380	$1,279	$1,278	$1,205
Weekly hours of semiconductor production workers (monthly average, Mar.)	41.3	40.0	40.0	40.1
Electronic components leadtime index (1977 = 100, May)	82.4	87.3	120.6	102.5
S&P's semiconductor stock price index (1970 =10, monthly average, Apr.)	74.6	67.8	55.9	54.7
Change in electronic components inventories ($ millions, SA, Mar.)	+$45	+$131	+$16	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, Mar.)	$41.0	$45.5	$44.6	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Department of Commerce , U.S. Bureau of Economic Analysis

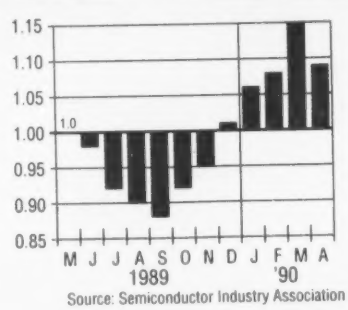
Semiconductor sales

North American market ($ billions)



Source: Semiconductor Industry Association

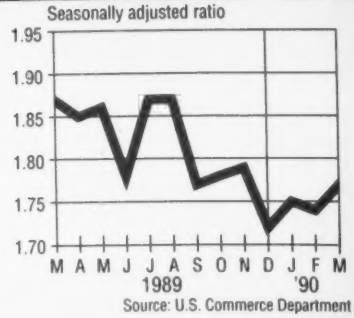
Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments

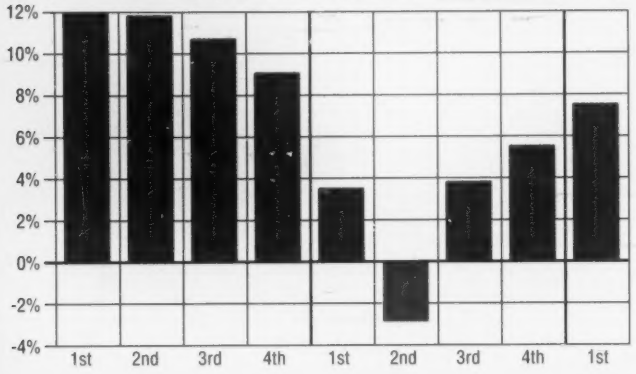
Seasonally adjusted ratio



Source: U.S. Commerce Department

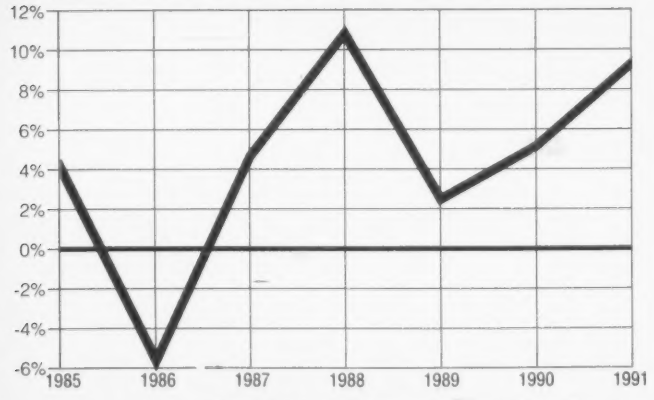
Growth in orders shows vitality...

Computer & office equipment orders (percentage change from year ago)



...helping to boost shipments growth in 1990

Computer & office equipment shipments (Annual percent change)



Source: U.S. Commerce Department; Forecast: Cahners Economics

Computer industry rebound or false start?

Evidence is mounting that the worst of the downturn may be over for computer manufacturers. Quarterly growth has been improving since the second quarter of 1989, and although shipments and orders for computers and office equipment dropped from March to April, they remain above year-ago levels. But growth could be uneven in coming months as the ELECTRONIC BUSINESS leading indicator forewarns of backsliding.

Between the first quarter of 1988 and the second quarter of 1989, the year-ago quarterly increase in new orders plummeted from a 12% growth rate to a negative 2.9%. Since then, the trend has reversed and the growth rate in new orders has been climbing steadily.

The hike in computer demand is favorably impacting shipments growth. At the end of 1989, shipments of computers and office equipment rose just 2.5%, the worst annual increase since the 5.6% decline in 1986. With the 12 months ending in April 1990, shipments advanced 3.7% compared to the prior 12 months. Furthermore, inventory growth is shrinking, resulting in April's inventory-to-shipments ratio of 2.1. That is the second lowest monthly ratio in seven months. These economic statistics prompted this forecaster to raise the estimate for this year's growth in computer and office equipment shipments to 5.1% from a previous 1.4%.

But there are threats to the forecast. The ELECTRONIC BUSINESS leading indicator leads the computer industry by about 12 months. This time last year the indicator was on the way down after a temporary rebound in the first quarter of 1989. That means the computer and office equipment sector could be in for another setback soon.

MADELINE FRANCHI

Computer market database

Latest quarter: 1st quarter, 1990	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA,1987=100, qtr. average)	144.80	138.80	+4.32%	133.40	+8.55%	154.20	+6.49%
Shipments (SA, $ millions, qtr. total)	$18,022	$17,325	+4.02%	$16,840	+7.02%	$19,137	+6.19%
New orders (SA, $ millions, qtr. total)	$17,817	$17,506	+1.78%	$16,570	+7.53%	$19,473.5	+9.30%
Unfilled orders (SA, $ millions, end of qtr.)	$12,453	$12,658	-1.62%	$13,201	-5.67%	$11,830	-5.00%
Inventory-to-shipment ratio (SA, end of qtr.)	2.01	2.11	—	2.08	—	1.97	—
All employees (thousands, end of qtr.)	464.20	475.90	-2.46%	474.80	-2.23%	442.40	-4.70%
Production workers (thousands, end of qtr.)	154.20	159.40	-3.26%	155.20	-0.64%	146.75	-4.83%
Business purchases (SAAR, current $ billions)	$46.50	$46.10	+0.87%	$44.10	+5.44%	$48.80	+4.95%
Business purchases (SAAR, 1982 $ billions)	$134.00	$131.38	+1.99%	$118.56	+13.02%	$150.19	+12.08%

SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted

Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, computers and office equipment. Forecasts: Cahners Economics